PATENT SPECIFICATION (11) 1 465 430

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(21) Application No. 14153/75 (22) Filed 7 April 1975 (19)
(31) Convention Application No. 460 606 (32) Filed 12 April 1974 in
(33) United States of America (US)
(44) Complete Specification published 23 Feb. 1977
(51) INT. CL.[2] B65G 27/34
(52) Index at acceptance
B8A 2A1 2A2 2A4X 2B1

(72) Inventor JACK WILLARD ARMSTRONG

(54) ACCUMULATOR AND FEEDER

(71) We, LIFE ROLLWAY CORPORATION, a corporation organised and existing under the laws of the State of New York, United States of America, of 4522, Wetzel Road, Liverpool, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an accumulator and feeder.

There are many situations during manufacture or processing of objects that one machine or operation puts out objects at a rate different from a succeeding machine or operation so that objects cannot be fed directly from one stage to the next and keep both stages operating at optimum rates. Hence, there is a need for an accumulator and feeder between such stages for accumulating objects supplied by one stage and feeding out objects on demand to the other stage so that both stages can operate at optimum speed. The various circumstances where an appropriate accumulator and feeder can have important advantages include both fast input-slow outpnt, and slow input-fast output, along with other variations such as multiple inputs or outputs, variable rate inputs and outputs, adjusting automatic processing at one stage to manual or variable processing at another stage, etc., and all of these variations can be applied to many different objects, feed rates, operating environments, and other variables.

The invention involves recognition of these problems and proposes a relatively simple, efficient, and adjustable accumulator and feeder to solve many of them. The invention aims at optimum rate of flow for objects, versatility in feeding different objects, substantial capacity both as an accumulator and a feeder, and convenient adaptation to a wide range of circumstances.

Our British Patent No. 1,321,191 claims a vibratory conveyor or feed apparatus comprising an element extending horizontally in the direction of feed and means for vibrating said element in which the element is surfaced with bristles of synthetic resin material or of metal in sufficient density and of sufficient strength that they are capable at their tips of supporting articles to be fed, the bristles being inclined towards the direction of feed.

According to the invention there is provided an object accumulator and feeder comprising:

(a) a relatively long path compared with the length of the accumulator and feeder for accumulating a supply of the objects, the path being divided into a series of independently operable sections and the upper surface of the said path having a pile material with bristles having tips supporting the objects and being inclined toward a directon of feed through the said accumulator and feeder;
(b) means for vibrating respective ones of the said sections independently to vibrate the pile bristles against the objects to feed the objects through the sections;
(c) a sensor arranged at a sensing regicn of each of the said sections for sensing the presence of the said objects in the sensing regions;
(d) timing means responsive to the sensor for determining whether the said objects are moving through the sensing regions or are stopped in the sensing regions; and
(e) means responsive to the said sensors and the said timing means for selectively operating the said vibrating means to accumulate the objects by successively filling up the said sections with the objects from the output end toward the input end of the accumulator and feeder, to feed the objects out of the accumulator and feeder on demand, and to shut off selected ones of the vibrat-

ing means for intervals during which the said selected ones of the vibrating means cannot advance the objects.

The invention is now described, by way of example, with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic block diagram showing how the accumulator and feeder are used;

Fig. 2 is a partially schematic, fragmentary plan view of the accumulator and feeder;

Fig. 3 is a fragmentary plan view of a portion of the accumulator and feeder of Fig. 2;

Fig. 4 is a fragmentary cross-sectional view of the accumulator and feeder of Fig. 2 taken along the line 4—4;

Fig. 5 is a fragmentary, side-elevational view of a section of the accumulator and feeder of Fig. 2; and

Fig. 6 is a schematic block diagram of the relationship between sensors and vibrators for the accumulator and feeder of Fig. 2.

The invention accumulator and feeder 10 is positioned between a supply machine 11 or other source of objects being processed, and accumulates the objects and feeds the objects to a receiving station 12 or another machine for subsequent processing of the objects. An alternative supply 13 and an alternative receiver 14 can also be used, and accumulator and feeder 10 can have any number of inputs or outputs to meet different circumstances. Accumulator and fedeer 10 has a relatively long through path 15 compared with its length for accumulating a supply of objects, and is configured to accommodate the particular objects and feeding speeds for each circumstance. The drawings show one preferred embodiment of the inventive accumulator and feeder, but many other embodiments of the same basic concept are possible.

As best shown in Fig. 2, accumulator and feeder 10 has the path 15 formed as multiple S curves leading through an input section 16, intermediate sections 17—19, and an output section 20. Any number of intermediate sections can be used as desired to achieve a satisfactory total length for path 15, and path 15 need not be in multiple S curves as illustrated. Path 15 can be established by guide rails or other barriers so that objects 25 follow the desired route through accumulator and feeder 10, and in the illustrated embodiment, path 15 is formed by a slot 21 receiving stems or projections 22 of objects 25.

The upper surface of accumulator and feeder 10 is covered with a pile material 23 having bristles 24 that support objects 25 on their tips and are inclined toward the desired direction of feed. Bristles 24 are preferably of uniform height and inclination and are dense enough and strong enough to support objects 25 on their tips. As best shown in Fig. 3, pile material 23 is arranged along the slot 21 of path 15 so that bristles 24 are inclined in the direction of the arrows to move objects 25 along the multiple S curves of path 15. Slot 21 is preferably formed by slight separation of individual strips of pile material 23 so that stems 22 of objects 25 extend down into slots 21, and objects 25 are otherwise supported on the tips of bristles 24 adjacent slot 21.

Each of the sections 16—20 of accumulator and feeder 10 is separate and independently operable, and the pile surface 23 of each section is vibrated preferably vertically and reciprocally by vibrators 26 secured to the underside of the feed surface and driven in a vertical vibrational mode as schematically represented by the arrows in Figs. 4 and 5. This vibrates bristles 24 against the bottoms of objects 25 and moves objects 25 in the direction of inclination of bristles 24 along the multiple S curve path 15. The junction between sections is preferably formed along a line 27 that cuts across path 15 and provides only a narrow gap for objects 25 to span as they proceeed from one section to another. Then each section moves objects 25 along to the succeeding section toward the output as described more fully below.

The path 15 with the slot 21 accommodates objects 25 that can be stably supported in the illustrated position with a stem or projection 22 extending downward into slot 21. One example of such objects 25 is instrument bodies for automotive dashboards, and such instrument bodies are generally cup-shaped and have downward extending stems. Bolts, screws, and similar items can be supported in the same way. For objects that do not have depending stems, slot 21 is omitted, and path 15 is formed by guide means above pile 23. Also a preferably transparent cover 28 is preferably arranged over pile 23 to keep objects 25 in place, to protect the machine from dirt or damage, and to allow visual inspection of the feed process.

Many different vibrators 26 can be used to drive pile 23, and vibrators 26 can be mounted under the support for pile 23 as illustrated, or can be mounted on a fixed base below the support for pile 23. Many different drives, including mechanical, pneumatic, hydraulic, electrical, and electromagnetic can be used in vibrators 26.

Bristles 24 of pile material 23 are preferably formed of synthetic resin monofilament, and can be obtained in various bristle diameters and lengths and bristle inclinations, depending on the objects to be fed.

Bristles 24 are practically noiseless in their engagement with objects 25. They do not mar or damage objects 25, and they are practically unimpaired by dirt, oil, moisture, and other environmental hazards.

Pile material 23 is preferably mounted on a substraight 29 supported on a base 30 that is driven vertically by vibrators 26. Base 30 is upheld by resilient, flexible supports 31, and cover 28 is supported by rods 32 in a fixed position over pile 23.

Output section 20 has two output paths 33 and 34 formed by slot 21 in pile material 23, and output of objects 25 is selectively alternated between paths 33 and 34. This is accomplished by a transfer slide 35 operated by a solenoid 36. In the position illustrated in Fig. 2, transfer slide 35 allows objects 25 to pass straight through to output path 34, and transfer slide 35 has a through transfer objects 25 to output path 33, a passageway 37 making this possible. To solenoid 38 positions a barrier 39 over the outlet from the through passageway 37 of transfer slide 35, and after an object 25 has entered slide 35, solenoid 36 moves slide 35 to align passageway 37 with output path 33; and then another solenoid 40 operates a pusher 41 to push objects 25 into output path 33. Bristles 24 of pile material 23 are inclined toward the direction of the arrows along output paths 33 and 34 so that objects 25 follow the desired course when output section 20 is vibrated by vibrators 26, Solenoids 36, 38, and 40 are synchronized in their operation and controlled so that objects 25 can all be directed along either output path or can be directed alternately between output paths 33 and 34. Control of the flow of objects 25 in output paths 33 and 34 can be either manual or automatic, depending upon the operations at the station 12 receiving objects 25.

If all the sections of accumulator and feeder 10 all vibrated continuously, a substantial feed pressure would build up as machine 10 filled with objects 25, because each section would be forcing objects 25 into the next, and if all the sections were full, their feed force would be added from section to section. This could build up enough feed pressure to jam or dislodge objects 25, and it would also be a waste of energy and produce needless wear in machine 10. According to the invention, the sections 16—20 of machine 10 are independently operated to vibrate sections only as needed, and to shut off vibrators for sections when objects cannot be advanced by operating the vibrators.

The way this works is each section has a sensor 50 alongside path 15 for sensing the presence of objects 25 in the vicinity of sensors 50. As best shown in Fig. 2, sensors 50 are arranged near the output end of each section, although sensors 50 can also be placed in many other positions. Output section 20 is vibrated any time an output is desired, and section 19 is vibrated any time section 20 is operating. Otherwise, the other sections of accumulator and feeder 10 are interrelated as schematically shown in Fig. 6.

In Fig. 6, vibrators 26 are identified by the letter V and successive sections of the accumulator and feeder are identified by letters A, B, C, and D. Corresponding sensors 50 are identified by the letter S and have corresponding section letter identifications. With sensors 50 arranged near the output region for each section, the general rule is that a succeeding section vibrator is shut off when objects stop moving in the preceding section, and a preceding section vibrator is turned on when objects start to move in a succeeding section. Timers 48 and 49 are each preferably adjustable to control these operations, and generally known equipment can be purchased and arranged as shown in Fig. 6 for use in the feeder and accumulator.

In operation, section D will be the first to fill up with objects, and as a motionless standing line of objects reaches the full length of section D and extends back to the sensor 50 of section C timer mechanism 48 responds to the lack of movement of objects sensed by sensor 50 in section C, and after a suitable interval of lack of motion of objects 25, shuts off the vibrator for section D. Section D is then filled with objects, but unable to move objects downstream, and is shut off until a downstream demand for objects occurs. If conditions remain unchanged and objects continue to enter the accumulator and feeder, they will fill up section C and form a stopped line reaching back to the sensor 50 of section B whereupon timer device 48 will shut off the vibrator for section C after a predetermined interval of stoppage of motion past the sensor 50 for section B. A similar process occurs if the stopped line of objects extends back to the sensor 50 for section A resulting in timer mechanism 48 shutting off the vibrator 26 for section B.

When a downstream demand for objects 25 occurs due to the operation of output section 20, final section D is switched on and objects then begin moving out of section D, and the sensor 50 of section D detects moving objects. Timer mechanism 49 responds to this, and after a suitable interval, switches on the vibrator for section C. Section C then begins vibrating to input objects into section D and replenish the objects' output from section D. Sensor 50 in section C detects movement of objects in section C feeding into section D, and timer mechanism 49 responds to this to

turn on the vibrator of section B after a suitable interval. If the feed rate through each section is fairly fast compared to the potential output rate, then timer mechanism 49 can be set for a longer delay before starting up a preceding section, because any section can quickly catch up with the downstream feed. If the feed rate through the accumulator and feeder is only slightly faster than the potential output, then preceding sections are turned on fairly quickly by timer 49 upon detection of downstream movement.

By arranging sensors 50 in different regions of each section, such as near the input region of a section, the logic of the operation would be altered, and a sensor could signal the shutoff of its own section when it detected parts standing still. Also, more than one sensor can be placed in each section, separate sensors can be used for stopping vibrators and starting up vibrators, and any system is preferably adjustable for optimum vibrator starting and stopping relative to input and output feed rates. Sensors 50 can be proximity sensors, optical devices, electromechanical switches, pneumatic sensors, or other devices, and timing mechanisms 48 and 49 cooperating with sensors 50 can also have many different forms.

Those skilled in the art will appreciate the many variations possible in adapting the accumulator and feeder of the invention to specific objects, numbers of objects, and input and output feed rates.

WHAT WE CLAIM IS:—

1. An object accumulator and feeder comprising:

(a) a relatively long path compared with the length of the accumulator and feeder for accumulating a supply of the objects, the path being divided into a series of independently operable sections and the upper surface of the said path having a pile material with bristles having tips supporting the objects and being inclined toward a direction of feed through the said accumulator and feeder;

(b) means for vibrating respective ones of the said sections independently to vibrate the pile bristles against the objects to feed the objects through the sections;

(c) a sensor arranged at a sensing region of each of the said sections for sensing the presence of the said objects in the sensing regions;

(d) timing means responsive to the sensor for determining whether the said objects are moving through the sensing regions or are stopped in the sensing regions; and

(e) means responsive to the said sensors and the said timing means for selectively operating the said vibrating means to accumulate the objects by successively filling up the said sections with the objects from the output end toward the input end of the accumulator and feeder, to feed the objects out of the accumulator and feeder on demand, and to shut off selected ones of the vibrating means for intervals during which the said selected ones of the vibrating means cannot advance the objects.

2. An object accumulator and feeder as calimed in claim 1 including means for output of the objects from the accumulator and feeder, the said output means including two paths for the objects and means for selectively directing the objects into the said two paths.

3. An object accumulator and feeder as claimed in claim 2 wherein the said output paths have the said pile material, and including means for vibrating the output means to vibrate the pile bristles against the objects to feed the objects through the said output means.

4. An object accumulator and feeder as claimed in any one of claims 1—3 wherein the said sensing regions are output regions of each of the said sections, and the said means responsive to the sensors and the timing means turn off one of the said vibrating means for a succeeding one of the said sections after detecting stopped objects in the one of the said sections feeding into the succeeding section, and turn on one of the said vibrating means for a preceding one of the said sections after detecting moving objects in the one of the said sections fed by the said preceding section.

5. An object accumulator and feeder as claimed in any one of claims 1—4 wherein the timing means includes means for adjusting variable intervals for starting and stopping the said vibrating means relative to the sensed presence of the said objects.

6. An object accumulator and feeder as claimed in any one of claims 1—5 wherein the said path is formed at multiple S curves.

7. An object accumulator and feeder as claimed in claim 6 wherein the said inclination of the pile bristles follows along the multiple S curves.

8. An object accumulator and feeder as claimed in any one of claims 1—7 wherein the vibrating means vibrates the sections vertically and reciprocally.

9. An object accumulator and feeder as claimed in any one of claims 1—8 wherein the pile material is arranged on opposite sides of a slot extending along the said path.

and the objects extend into the said slot and rest on the bristle tips adjacent the said slot.

10. An object accumulator and feeder substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicants,
CARPMAELS & RANSFORD,
Chartered Patent Agents,
43, Bloomsbury Square,
London WC1A 2RA.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1977.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1465430 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

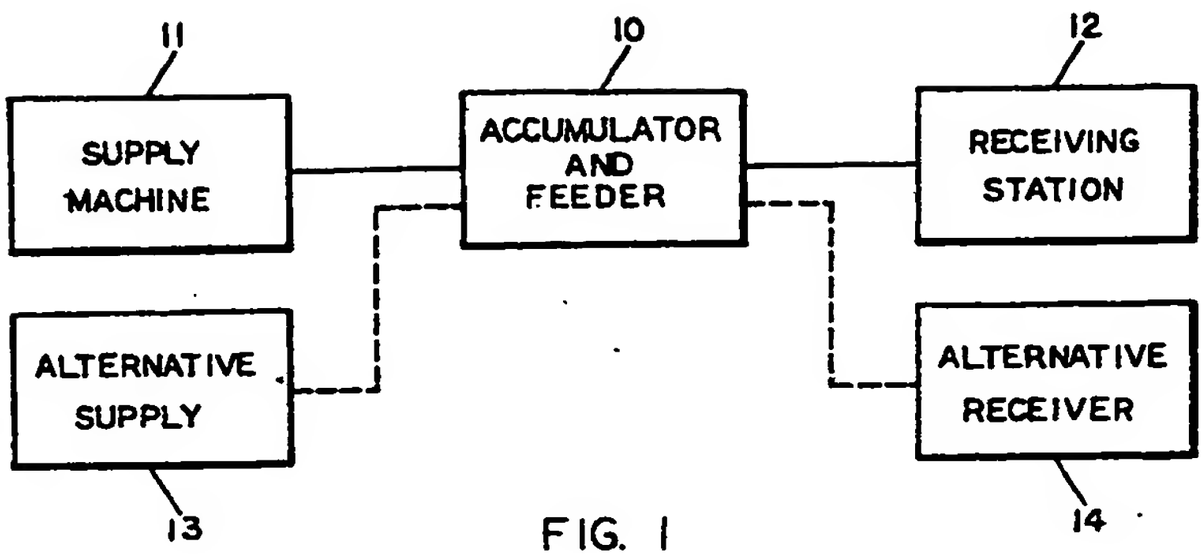

FIG. 1

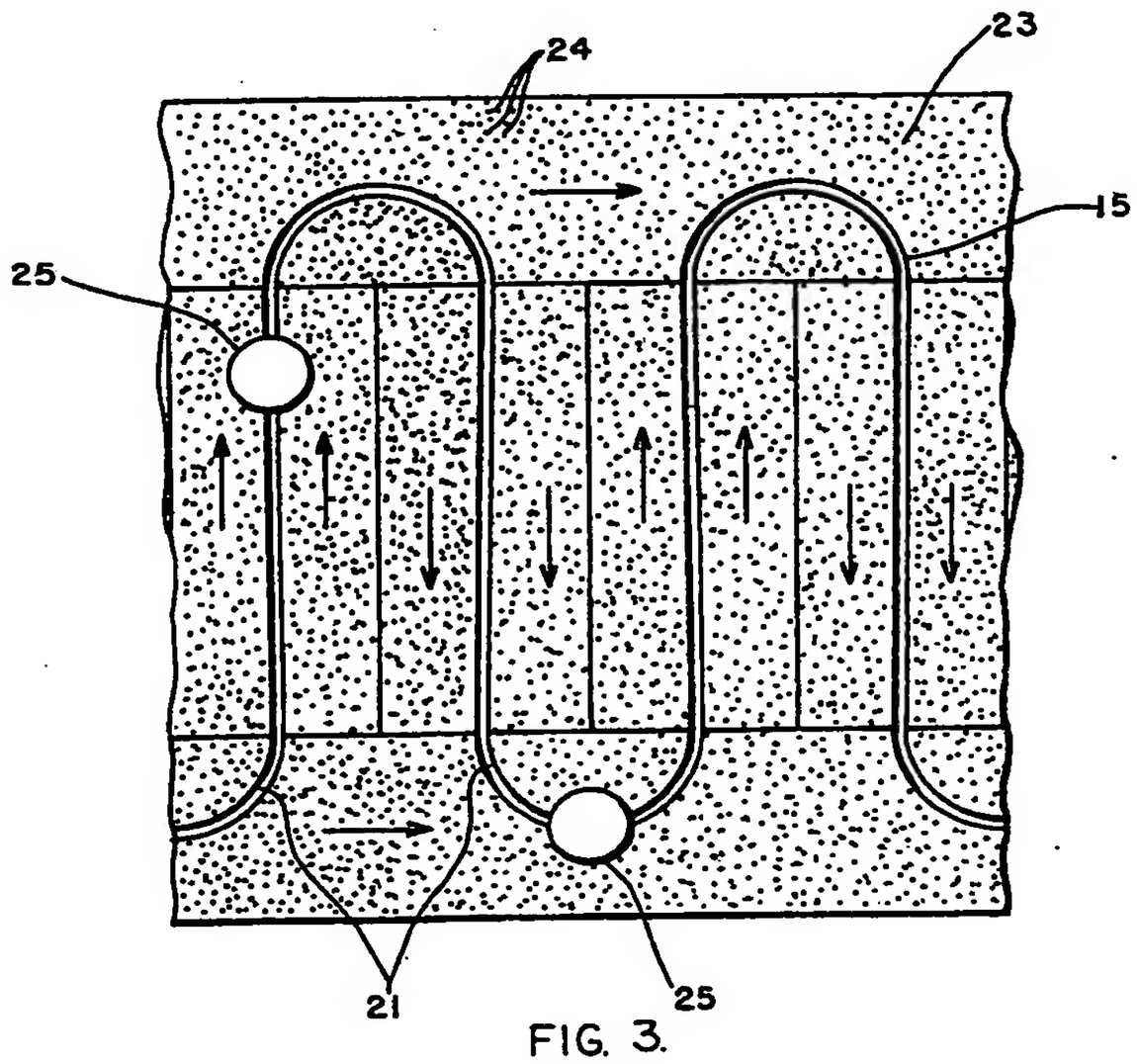

FIG. 3.

1465430 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

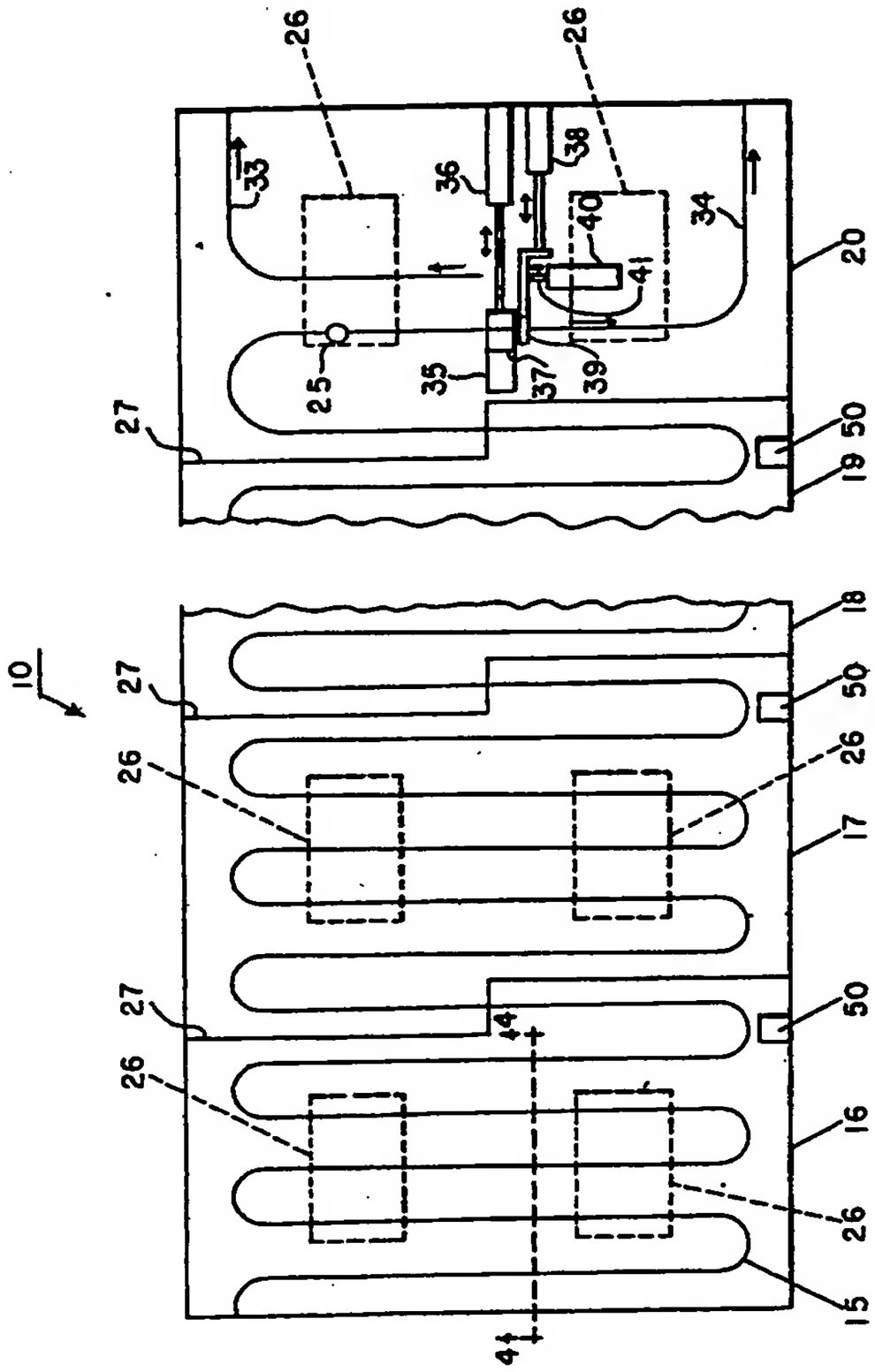

FIG. 2.

1465430 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
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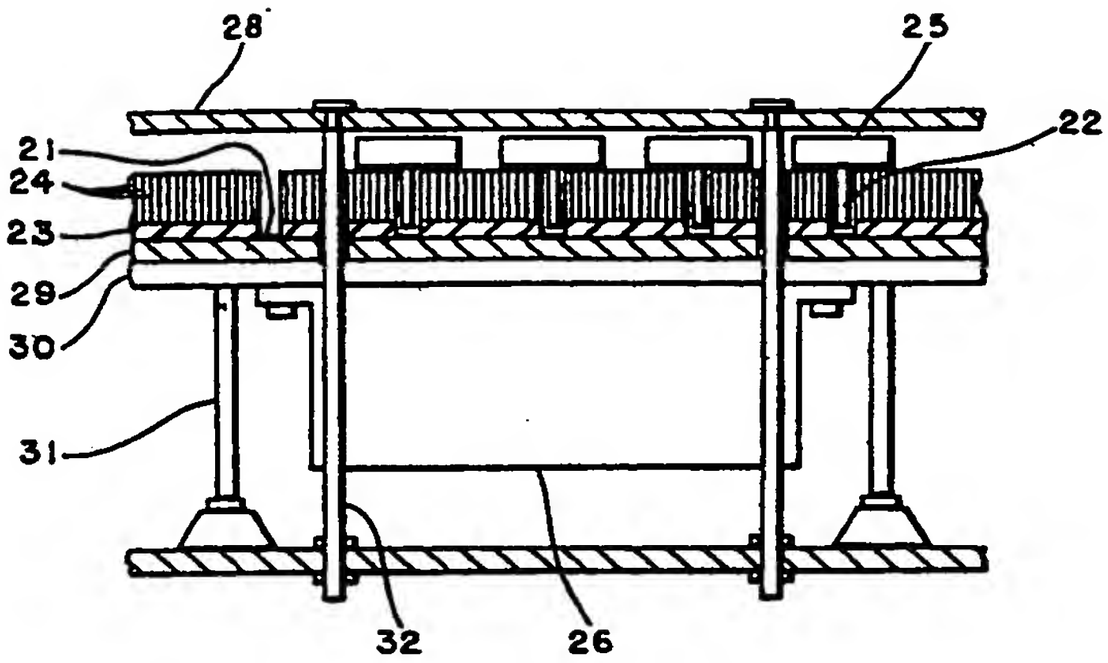

FIG. 4.

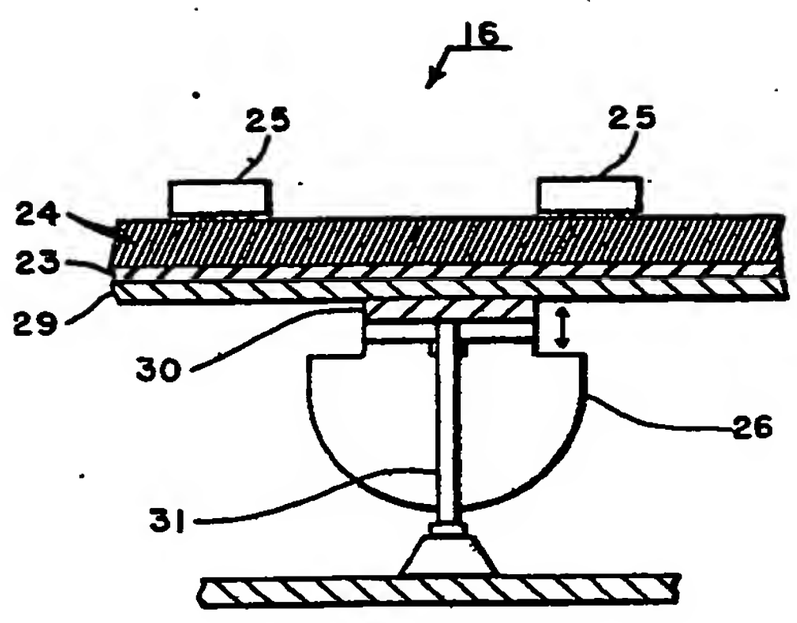

FIG. 5.

1465430
4 SHEETS

COMPLETE SPECIFICATION

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Sheet 4

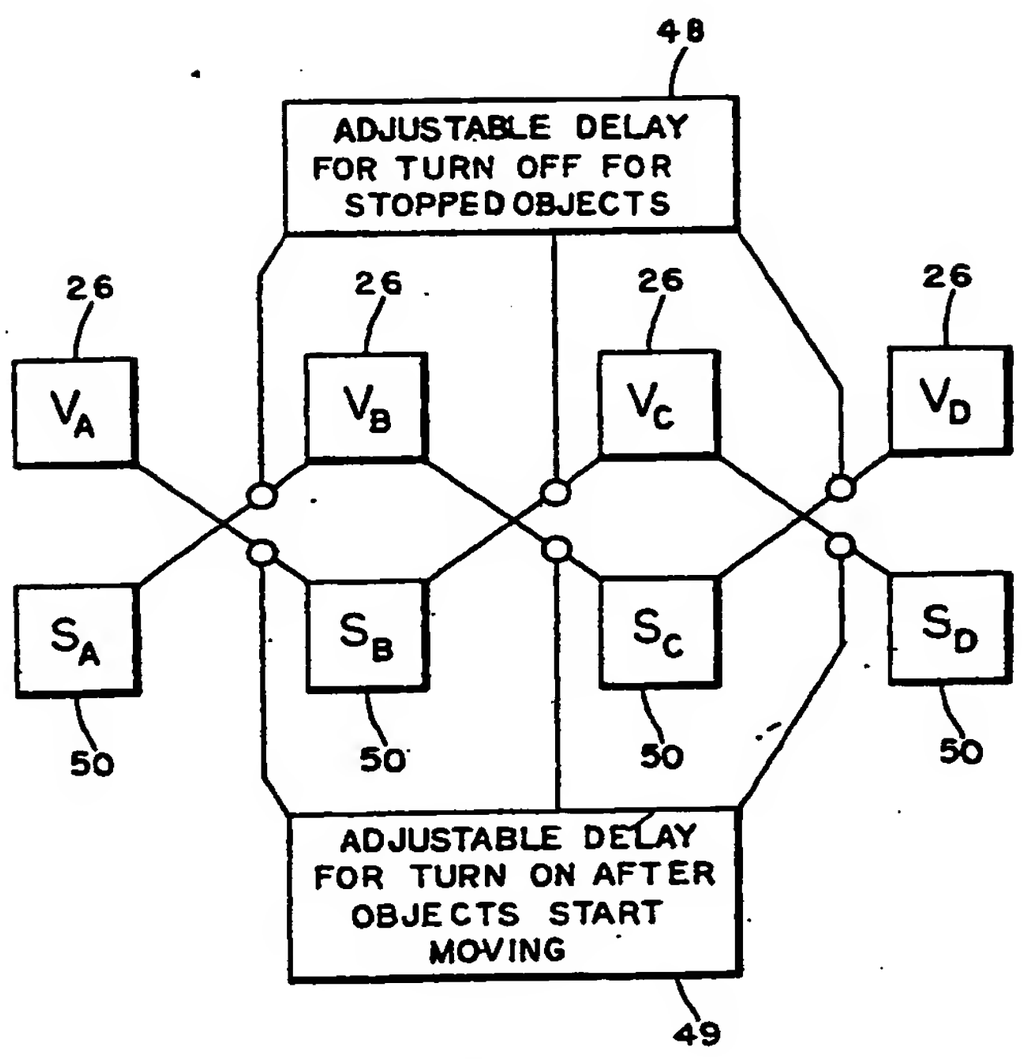

FIG. 6.